# Market Performance Implications of the Transfer Price Rule*

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**Abstract**

The "transfer price rule" (TPR) defines a vertical price squeeze as an input price, output price combination set by a vertically-integrated firm monopoly producer of an essential input that would not allow the firm's downstream unit to earn at least a normal rate of return on investment in the "as-if" case that it had to purchase the input at the price charged independent firms. In its 2009 *linkLine* decision, the U.S. Supreme Court rejected the TPR for the purpose of enforcing the anti-monopolization prohibition of Section 2 of the Sherman Act. In contrast, a vertical price squeeze, defined by a TPR-like standard, is an abuse of a dominant position under Article 102 of the Treaty on the Functioning of the European Union (TFEU). In this paper, we model the impact of the TPR on market performance. We find that the TPR increases consumer surplus and net social welfare if all firms remain active in the downstream market. It sometimes induces the upstream firm to refuse to supply the downstream firm, and in such cases, consumer surplus and net social welfare are reduced. The impact of the TPR on market performance thus depends on whether or not an upstream firm can refuse to supply downstream firms on terms that would offer it at least a normal rate of return on investment.

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# 1 Introduction

A pricing strategy open to a firm that operates in an imperfectly competitive downstream market and simultaneously supplies its rivals in that market with an essential input over which it exercises some market power is to set a high wholesale price for the input and a low final good price for the output. The issue raised for antitrust and competition policy by such a price squeeze is the impact of the potential exclusion of equally efficient horizontal competitors in the downstream market on consumer surplus and net social welfare.

Vertical price squeezes were part of the youth and early adulthood of U.S. antitrust.[1] They are central to recent U.S. antitrust and EU competition policy cases involving monopolization and abuse of a dominant position. Many of these cases arise in markets where downstream firms supply internet access to final consumers, using as an essential input the upstream telecommunications infrastructure of vertically-integrated firms that also operate in the downstream market.

In the United States, the *linkLine* antitrust decision[2] involved just such vertical relationships. The dispute was between four California internet service providers (ISPs) of retail digital subscriber line (DSL) internet access, who purchased wholesale transmission services from the vertically-integrated Pacific Bell Telephone Co. (later, and in what follows, AT&T), which itself supplied DSL internet access to the retail market.[3] In July, 2003, the ISPs filed a private antitrust suit alleging that AT&T had monopolized and attempted to monopolize the regional DSL market in violation of Section 2 of the Sherman Act (503 F. 3d 876 at 878), in among other ways by "creat[ing] a price squeeze by charging ISP[s] a high wholesale price in relation to the price at which defendants were providing retail services."

The ISPs prevailed in District Court and the Circuit Court of Appeals, and AT&T turned to the Supreme Court. In its opinion, the Supreme Court saw no need to view "price squeeze" as a distinct exclusionary strategy for antitrust purposes. It decomposed "vertical price squeeze" into two parts, each of which could be treated according to existing antitrust standards. First, the high wholesale price that is the lower prong of a price squeeze is an exercise of monopoly power, which for antitrust economics is the ability to control price or exclude competition. The exercise of lawfully obtained market power does not offend the Sherman Act Section 2 prohibition of monopolization.[4] Second, the

[1] U.S. *v.* Corn Products Refining Co. *et al.* 234 F. 964 (1916), U.S. *v.* Aluminum Co. of America *et al.* 148 F.2d 416 (2d Cir. 1945). See Section 2.1 for discussion. The opinions in both cases were authored by Judge Learned Hand.

[2] Pacific Bell Telephone Co. *et al. v.* linkLine Communications, Inc., *et al.* 555 U. S. 438 (2009).

[3] The *linkLine* decisions treated DSL internet access as the relevant product market. At this time and in this geographic market, DSL, dial-up, and cable modem were alternatives available to final consumers. The outcomes of these decisions did not, however, turn on the question of product market definition.

[4] In contrast, under Article 102 of the Treaty on the Functioning of the European Union the exercise of market power may be considered an abuse of a dominant position. See Section

low retail price that is the upper prong of a price squeeze is monopolization if it is predatory, otherwise not.[5]

In dictum, the Supreme Court rejected application of an approach suggested by the American Antitrust Institute in a friend-of-the-court brief, the "transfer price rule" (TPR), to vertical price squeezes.[6] The transfer price rule would find a monopolization violation of Section 2 if (555 U. S. 454) "the upstream monopolist could not have made a profit by selling at its retail rates if it purchased inputs at its own wholesale rates."

When it rejected use of the transfer price rule, the Supreme Court did so without analysis of its impact on market performance, simply stating (555 U. S. 454):

> Whether or not that test is administrable, it lacks any grounding in our antitrust jurisprudence. An upstream monopolist with no duty to deal is free to charge whatever wholesale price it would like; antitrust law does not forbid lawfully obtained monopolies from charging monopoly prices.

In this paper, we analyze the impact of the transfer price rule on market performance. We do so in a model of price-setting duopoly with linear demand for horizontally differentiated products, and we allow for differences between firms in fixed cost and sunk entry cost.[7]

To preview our results, if the downstream unit of the vertically integrated firm has low unit cost, its downstream unit would satisfy the TPR for the unconstrained wholesale price of the essential input. If the varieties of the two firms are close substitutes, the vertically-integrated firm will refuse to deal with the downstream firm whether or not the TPR is in place. In either case, the TPR does not affect the integrated firm's decisions.

Outside these two cases, the TPR alters the integrated firm's decisions in one of two ways. Either it continues to supply to downstream firm, but on terms (a combination of lower wholesale price and higher output price) that allow the integrated firm's downstream unit to "pseudo-break even," satisfying the TPR, or it refuses to supply the downstream firm, even though it would find it profitable to do so if the TPR were not in effect. Some welfare consequences

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2.4.

[5] Under, *inter alia*, *Brooke Group*, a price is predatory if it is below an appropriate measure of unit cost and if the firm charging the price would have an objectively reasonable expectation of recouping profits lost while setting a predatory price. EU competition policy takes demonstration of a price below unit cost as establishing that a firm expected to be able to recoup predatory losses; no separate demonstration of recoupment is required to find that a price below unit cost abuses a dominant position (Tetra Pak II (Case C-333/94 P Tetra Pak International SA *v.* Commission 1996 ECR I-5951) ¶ 44, *Wanadoo* (France Télécom SA v Commission Case C-202/07 P), 33.)

[6] One author of this paper is a member of the Advisory Board of the American Antitrust Institute. He was not involved in any way in preparation of the aforementioned brief.

[7] In Martin and Vandekerckhove (2010), we allowed as well for vertical product differentiation, and obtained results generally similar to those presented here. We discuss the more general model in Section 7.

of the TPR depend on the degree of product differentiation, but in general we find that the TPR increases consumer surplus, net social welfare, or both if both firms remain active in the downstream market. If the TPR induces the upstream firm to refuse to supply the downstream firm when it would otherwise choose downstream duopoly, consumer surplus, net social welfare, or both are reduced.

We review related work in Section 2, and outline our basic analytical framework in Section 3. In Section 4 we analyze the upstream firm's equilibrium choice of distribution mode if it is not subject to the transfer price rule. In Section 5, we discuss the implications of the transfer price rule for the upstream firm's equilibrium choice of distribution mode and for market performance. Section 8 concludes. An outline of derivations are given in the appendix at the end of this paper; complete derivations are contained in an appendix that is available from the authors on request.

# 2 Literature Review

Our topic touches on work in four distinct but related areas: U. S. antitrust decisions, the antitrust economics literature on exclusion generally and vertical exclusionary strategies in particular, the regulation of vertically-integrated firms, and the treatment of vertical price squeezes under EU competition policy.[8]

## 2.1 Antitrust decisions

As noted above, two early U.S. monopolization decisions involved vertical price squeezes. One of the dominant firms that emerged in U.S. markets at the start of the 20th century was the Corn Products Refining Company, which at its formation in 1906 accounted for 91 per cent of corn ground in the United States, all glucose, and 64 per cent of starch production.[9] Watkins (1927, p. 210) describes the business as an "ordinary manufacturing industry [in which] no economies in production are to be gained, simply by combining numerous widely scattered plants, which outweigh the potential wastes of a cumbrous administration." Corn Products Refining faced competition from entrants, and pursued a number of strategies to maintain its market position, including retroactive loyalty rebates, inducing railroads to raise rivals' rates, the use of a "bogus independent" to set selective (targeting rivals' customers) predatory prices, and a vertical price squeeze, making the price of mixed syrup and the glucose from which it was made "substantially an equality," leaving no margin for independent mixers. Judge Hand found that Corn Products Refining sold its Karo

[8] There is a broader literature on transfer pricing within firms. What Raimondos-Møller and Scharf (2002, p. 230) refer to as the "arm's length" standard for transfer pricing within multinational firms, that "a transfer price is deemed appropriate if it is equal to the price at which two independent arm's length parties would trade" is similar in spirit to the transfer price rule. We thank a referee for this reference.

[9] For details, see U.S. v. Corn Products Refining 234 F. 964 at 968-975 or Watkins (1927, pp. 201-211).

brand mixed syrup at a loss. There was also a refusal to deal (234 F. 964 at 1006). But he concluded that the plan to exclude mixers "from their subindustry" had not succeeded "to the extent that [Corn Products Refining] planned," and found the company guilty of attempting to monopolize mixed syrups but not of monopolization.

Some 25 years later, one of the practices for which the government reproached Alcoa, the Aluminum Company of America, in the antitrust suit that began in 1941, was squeezing the margin between the price of aluminum ingot sold to independent rollers and the price of sheet aluminum (148 F. 2d 416 at 437):

> The plaintiff's theory is that 'Alcoa' consistently sold ingot at so high a price that the 'sheet rollers,' who were forced to buy from it, could not pay the expenses of 'rolling' the 'sheet' and make a living profit out of the price at which 'Alcoa' itself sold 'sheet.'

Judge Hand's characterization of Alcoa's vertical pricing as failing to allow downstream rollers "a living profit" has received two very different readings. For Sidak (2008, p. 283), for example, it embodies a protectionist vision of antimonopolization law: "Judge Hand's key concept—that a competitor is entitled to receive a "living profit"—is irreconcilable with the consumer-welfare objective of antitrust law that the Supreme Court and the antitrust enforcement agencies have emphasized for at least three decades." Hovenkamp and Hovenkamp, in contrast, view the 1945 circuit court opinion as protecting only the opportunity for nonintegrated firms to demonstrate in the marketplace that they are as efficient as the downstream unit of the integrated firm (2009, pp. 474–475):[10]

> While Judge Hand wrote of the independent fabricator's legal entitlement to a "fair price" from Alcoa, he in fact employed a cost-based test. The test was that the margin between the price at which Alcoa sold sheet to the independent rollers and its own resale price for rolled aluminum must be at least sufficient to cover the costs that Alcoa itself incurred for the same set of processes. In other words, Judge Hand applied a somewhat primitive version of an "equally efficient rival" test, such as the one that Judge Posner has advocated for unlawful exclusionary conduct assessed under Section 2 of the Sherman Act.

We develop a formal model that permits assessment of the impact of a rule that protects the opportunity of an equally-efficient downstream rival to compete on consumer welfare.

## 2.2 Antitrust economics

Limiting the ability of dominant firms to exclude equally-efficient rivals is one of the two pillars — the other being prohibition of collusion — upon which U.S.

[10] We omit two footnotes, one of which cites Posner (2001, pp. 194-195).

antitrust policy was erected (Klebaner, 1964; Baker, 2012). Over the more than 30 years during which he wrote on trusts, John Bates Clark (1900a, b, elsewhere) came to favor the kinds of policies eventually embodied in the 1914 Clayton Act — prohibiting predatory pricing, price discrimination that distorted competition,[11] and exclusive dealing contracts between manufacturers and distributors — that he believed would fortify the (1904) "saving grace" of potential competition.[12] This done, he saw no need to limit the ability of the large firm to compete (1900b, p. 195): "Make the independent competitor safe and let prices be gauged by the cost of the goods that are made in his well-equipped establishment. Let him make a fair living; and if the trust, by real economy, makes a better living, no one will complain."

The papers in the literature that come closest to our contribution are Carlton (2008) and Vickers (2010). Carlton reaches a negative conclusion about imposing antitrust liability for vertical price squeezes. He sets up his discussion as follows (pp. 271-272, footnote omitted):

> Assume that Product A is a necessary input in the production of Product B and that Product B is produced in a fixed proportion to the quantity of Product A used as an input. Although it has no effect on the results, assume for exposition that one unit of Product A is required to produce one unit of Product B. Assume that Firm 1 is a vertically integrated producer of Product A and Product B. Assume that Firm 2 purchases Product A from Firm 1 at price $P_A$ and sells Product B at price B in competition with Firm 1. Furthermore, assume that Firm 1 is a monopolist seller of Product A. Suppose Firm 2's profit margin ($P_B - P_A$) declines to a level so low that Firm 2 exits the market. Should Firm 1's actions be subject to condemnation under the antitrust laws because it leads to some harm that is not actionable under other antitrust causes of action and, if so, under what circumstances?

For Carlton (2008, p. 275), the case that the downstream market can be treated as if it is perfectly competitive is "the standard one."[13] While he discusses the way product differentiation in the downstream market affects results, his base model is one in which the product traded in the downstream market is homogeneous. Vickers (2010) maintains the assumption of downstream product

[11] It was price discrimination of the kind typified by railroad rate discrimination that was the target of this policy approach. Such discrimination enabled the rise of Standard Oil (Prouty, 1900; Granitz and Klein, 1996); the American Sugar Refining Company benefited from similar arrangements.

[12] See Gordon (1963) on the early views of Clark and others before passage of the Sherman Act in 1890, Gilbert (1989) for a survey of the economic literature on the impact of potential competition on market performance.

[13] If the downstream market is perfectly competitive, then the Chicago School "single monopoly profit argument" holds and a vertical price squeeze cannot increase the upstream firm's economic profit. The Chicago argument fails if the downstream market is imperfectly competitive; see, for example, Hart and Tirole (1990).

homogeneity, and treats nonintegrated firms in the downstream market as a price-taking fringe.

In contrast to these approaches, the price squeeze claims that have been the basis of antitrust disputes involve imperfectly competitive downstream markets and markets which (like most markets) are for differentiated products. We differentiate our own work from these two contributions by formally modelling the impact of a rule that defines vertical pricing that violates the transfer price rule as monopolization on market performance if the downstream market is imperfectly competitive and downstream varieties are differentiated.

## 2.3 Regulation

There is a large literature on the pricing of essential inputs across vertically-related industries, some of which are regulated. Much of this work examines telecommunications pricing policy under alternative regulatory regimes. In this context, King and Maddock (2002) discuss alternative "imputation rules."[14] Such rules correspond to the transfer price rule (2002, p. 48):

> An imputation rule can detect a price squeeze. The rule evaluates the integrated firm's pricing policy as if it faced the same access costs as its non-integrated retail competitors. As a result, the rule detects when prices are unviable for (equally efficient) retail competitors.

The terminology "imputation rule" arises because (Hausman and Tardiff, 1995, p. 543, emphasis added): "*the price [the upstream firm] charges to competitors is imputed into its own price for competing services* with cost differences in providing the monopoly service element being recognized so that economic efficiency is achieved ...."[15] Our work differs from the analysis that appears in this literature in that we model pricing in unregulated vertically-related industries.

Noll (1995, p. 502) observes that "Most policy disputes in telecommunications refer to vertical foreclosure" and that (p. 503) "A firm with market power can follow two types of vertical foreclosure strategies: refusal to deal, and exclusionary pricing." Noll defines a price structure as exclusionary (p. 505) "if prices in a monopolized market disadvantage competitors in a vertically related market," and discusses vertical price squeezes as an exclusionary strategy. He comments that (1995, p. 506) "The unfortunate downside to price squeeze claims is that any cure may introduce regulations guaranteeing minimum retail margins that keep inefficient competitors in business." This is a downside that the transfer price rule avoids.

[14] Hausman and Tardiff (1995, p. 543, emphasis added): "The imputation rule states that a LEC will be required to provide 'monopoly service elements' *where the price it charges to competitors is imputed into its own price for competing services* with cost differences in providing the monopoly service element being recognized so that economic efficiency is achieved. ...."

[15] See Polo (2007) for an exposition of conditions under which the transfer price rule is equivalent to the efficient component pricing rule of Baumol and Sidak (1994).

### 2.4 Vertical exclusion under EU competition policy

The European Commission and the European Courts have applied the transfer price rule, although not by that name.[16] In its 2003 *Deutsche Telekom* decision,[17] the Commission wrote (¶ 140) that "a margin squeeze occurs if the spread between [Deutsche Telecom's] retail and wholesale prices is either negative or at least insufficient to cover [Deutsche Telekom's] own downstream costs. This would mean that [Deutsche Telekom's] would have been unable to offer its own retail services without incurring a loss if, during the period under investigation, i.e. since 1998, it had had to pay the wholesale access price as an internal transfer price for its own retail operations." This rule, which maintains the opportunity for a nonintegrated downstream firm to compete, appears in the Commission's 1988 *Notice on the application of the competition rules to access agreements in the telecommunications sector*.[18] That Notice also raises the possibility that abuse by a dominant firm might be found if the downstream margin is (emphasis added) "insufficient to allow *a reasonably efficient service provider* in the downstream market to obtain a normal profit."

Clerckx and De Muyter (2009) defend the reasonably-efficient competitor standard emphasizes that dominant telecom firms in EU member state markets tend to have inherited their positions from a state enterprise or regulatory past. Be that as it may, it is subject to skepticism on at least two grounds, one of principle and one from the point of view of application. The objection in principle is that it might protect less efficient downstream firms from the competition of more efficient vertically-integrated firms. The practical objection is that a "reasonably efficient downstream firm" test would require the upstream firm to know the costs of its rival to avoid offending competition policy, while the transfer price rule requires only that the upstream firm to know the costs of its own downstream unit.

## 3 Setup

We model a vertically-structured market in which one firm, firm A, is the monopoly supplier of an essential input for production of a final good. We suppose that one unit of the essential input is required to produce one unit of the final product, and that the essential input is produced at constant marginal cost, which, for simplicity, we normalize to be zero. Vertical price squeezes have been an issue in cases where upstream and downstream markets are small-numbers oligopolies. We assume that the essential input is supplied by one firm, and focus on a downstream market — this may be thought of as one

[16] See *Wanadoo* (cited in footnote 5), *Deutsche Telekom* (Case C-280-08 P 14 October 2010 (ECJ), *TeliaSonera* Case C-52/09 17 February 2011 (ECJ) (TeliaSonera). For discussions, see Grout (2003), Motta and de Streel (2006), Polo (2007), Clerckx and De Muyter (2009), Hay and McMahon (2012).

[17] Commission Decision of 21 May 2003 Deutsche Telekom AG [2003] OJ L263/9, 14.10.2003. See similarly the Commission's 1988 *British Sugar* decision, [1988] OJ L 284 [1988], ¶ 66.

[18] OJ 98/C 265/02, ¶ 117. The "reasonably efficient competitor" test appears in ¶ 118.

of several nonoverlapping regional markets — that is supplied by at most one nonintegrated firm. By focusing on the limiting case of one upstream and one downstream firm, we avoid highlighting horizontal relationships among firms operating at the same horizontal level at the expense of the vertical relationships upon which we wish to focus.[19]

## 3.1 Demand

We allow for horizontal product differentiation in the final good market by using the standard Spence-Dixit-Vives linear demand specification. Without loss of generality, we normalize the price-axis intercept of the inverse demand equation to be 1, and the slope of the inverse demand equation to be $-1$. The inverse rate of demand equation for variety $i$ is

$$p_i = 1 - q_i - \sigma q_j, \tag{1}$$

where (here and henceforth) $i$, $j = A$, $B$ and $i \neq j$. $\sigma$ is a horizontal product differentiation parameter. We assume $0 \leq \sigma < 1$. $\sigma = 0$ implies varieties are independent in demand. In the limiting case $\sigma = 1$, varieties are perfect substitutes.

As is well known, inverse demand equations of this form can be derived from a quadratic social welfare function

$$U = H + q_A + q_B - \frac{1}{2}\left(q_A^2 + 2\sigma q_A q_B + q_B^2\right), \tag{2}$$

where $H$ is a Hicksian composite good, price normalized to 1, produced by a perfectly competitive industry under conditions of constant returns to scale. We use (2) for welfare calculations.

In what follows, we model price-setting firms, and work with the demand equations implied by (1),

$$q_A = \frac{1}{1-\sigma^2}\left(1 - \sigma - p_A + \sigma p_B\right) \tag{3}$$

and

$$q_B = \frac{1}{1-\sigma^2}\left(1 - \sigma - p_B + \sigma p_A\right). \tag{4}$$

We treat time as continuous; (3) and (4) are the rates of demand per unit time period.

## 3.2 Cost

If firm $i$ enters the downstream market, it incurs a completely sunk entry cost $E_i$ $(i = A, B)$ and fixed cost at the rate $F_i$ per unit time. It also incurs a constant marginal cost per unit of output for all inputs other than the essential input produced by firm A. Without loss of generality, and for notational simplicity, we normalize this marginal cost to be zero.

[19] By allowing at most one independent downstream firm, we also rule out "hold up" effects in vertical relationships of the kind considered by Hart and Tirole (1990).

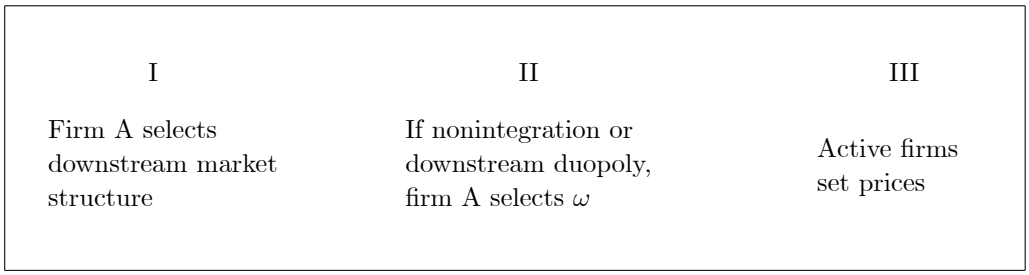


Figure 1: Sequence of decisions.

### 3.3 Sequence

There are at most three stages in the market (Figure 1). In stage I, firm A chooses the structure of the supply side of the downstream market (Figure 2). Firm A may choose to supply the downstream market as a monopolist, refusing to supply firm B with the essential input and so excluding it from the final good market. Firm A may choose *downstream duopoly*, integrating downstream and competing with firm B, to which it supplies the essential input at wholesale price $\omega$. The third possibility is *nonintegration*: firm A may operate only upstream, leaving firm B, which again purchases the essential input at wholesale price $\omega$, as the monopoly supplier of the downstream market.

In stage II, which occurs only if firm A opts for downstream duopoly or nonintegration, firm A sets the wholesale price $\omega$. We treat constructive refusal, in which firm A announces that it will supply the essential input to firm B at a price that makes it uneconomic for firm B to purchase the essential input, as a form of exclusion. Thus if firm A opts for duopoly distribution, it sets a wholesale price that maximizes firm A's value, assuming that firm B earns at least a normal rate of return on investment. We assume that firm B enters the downstream market if and only if entry will allow it to earn at least a normal rate of return on investment.

Finally, in stage III, firms that are active in the downstream market set prices to maximize own present-discounted value over all future time. If there is downstream duopoly, prices are set non-cooperatively. The game is solved backward.

## 4 Alternative Final Market Structures

We first consider firm A's equilibrium choice of downstream market structure, and the resulting market performance, if the transfer price rule is not in place.

### 4.1 Firm A monopoly/Firm B monopoly

If firm A refuses to supply firm B with the essential input, or withdraws from the downstream market, the downstream market is a monopoly supplied at constant

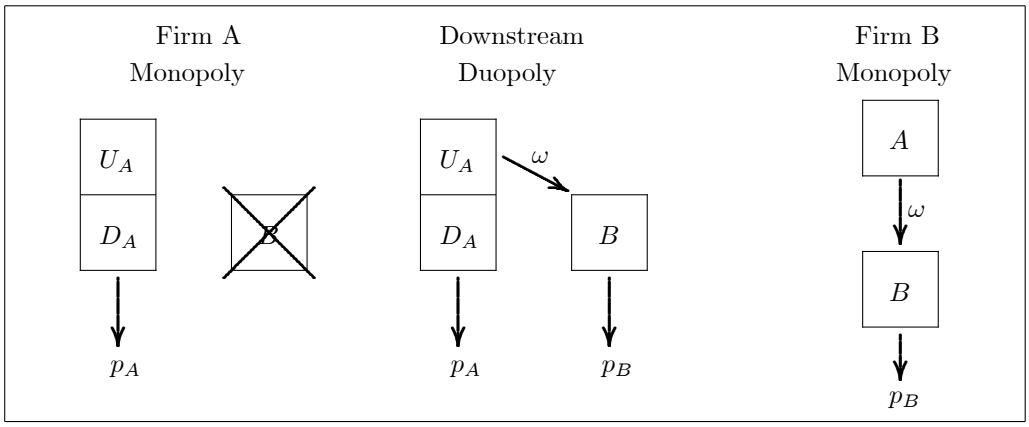


Figure 2: Alternative downstream market structures.

| | Firm A monopoly | Firm B monopoly |
|---|---|---|
| $\omega$ | NA | 1/2 |
| $q_A$ | 1/2 | NA |
| $q_B$ | NA | 1/4 |
| $p$ | 1/2 | 3/4 |
| $rV_A$ | $\frac{1}{4} - k_A$ | 1/8 |
| $rV_B$ | NA | $\frac{1}{16} - k_B$ |
| $rCS$ | 1/8 | 1/32 |
| $rNSW$ | $\frac{3}{8} - k_A$ | $\frac{7}{32} - k_B$ |

Table 1: Equilibrium outcomes, final good market monopoly.

marginal cost. Marginal cost is normalized to be 0 if firm A is the monopoly supplier, $\omega$ if firm B is the monopoly supplier.

As noted above, we treat time as continuous. Then if, for example, firm A excludes firm B, its objective function is its present discounted value,

$$V_A^{ex} = -E + \frac{1}{r}\left[\left(1 - q_A^{ex}\right) q_A^{ex} - F_A\right]$$

$$= \frac{1}{r}\left[\left(1 - q_A^{ex}\right) q_A^{ex} - \left(F_A + rE_A\right)\right] = \frac{1}{r}\left[\left(1 - q_A^{ex}\right) q_A^{ex} - k_A\right], \tag{5}$$

where the interest rate $r$ is used to discount income and for notational compactness we write

$$k_i = F_i + rE_i \tag{6}$$

for the sum of firm $i$'s flow fixed and capitalized sunk entry cost.

It is straightforward to arrive at the equilibrium characteristics of the two monopoly regimes, and these are given in Table 1.

Note from Table 1 that the monopoly values of the two firms are

$$V_A^m = \frac{1}{r}\left(\frac{1}{4} - k_A\right) \tag{7}$$

and

$$V_B^m = \frac{1}{r}\left(\frac{1}{16} - k_B\right),$$

respectively.

If $k_A > \frac{1}{4}$, firm A would never choose to be the monopoly supply of the downstream market, and if $\frac{k_B}{\rho} > \frac{1}{16}$, firm B would never agree to be the monopoly supply of the downstream market. So as not to rule out either exclusion or nonintegration by assumption, in what follows we assume

$$k_A \leq \frac{1}{4}, \tag{8}$$

$$k_B \leq \frac{1}{16}, \tag{9}$$

and so limit our attention to cases in which any one of the distribution regimes is a feasible equilibrium outcome. In the present context, (8) and (9) correspond to the standard assumption that fixed cost is small enough, relative to market size, that a monopolist would not lose money.

## 4.2 Downstream Duopoly

### 4.2.1 Stage III: Retail Prices

If firm A opts for duopoly in the final good market, firms A and B compete as price-setting duopolists in stage III. Firm B takes as given the wholesale price $\omega$ set by firm A in stage II. Firm A's objective function is the present value of the sum of its profit from sales of the final good and its profit from sales to firm B of the essential input,

$$V_A^{dd3} = \frac{1}{r}\left[p_A q_A\left(p_A, p_B\right) - k_A + \omega q_B\left(p_A, p_B\right)\right], \tag{10}$$

where $q_A\left(p_A, p_B\right)$ and $q_B\left(p_A, p_B\right)$ are the demand equations (3) and (4).

Firm B's objective function is the present value of profit from its sales of the final good,

$$V_B^{dd3} = \frac{1}{r}\left[\left(p_B - \omega\right) q_B^{dd3}\left(p_A, p_B\right) - k_B\right]. \tag{11}$$

The first-order conditions to maximize (10) and (11) are linear equations that can be solved for equilibrium prices as functions of $\omega$. All other equilibrium characteristics of interest — quantities demanded $q_A^{dd2}(\omega)$ and $q_B^{dd2}(\omega)$, values, and consumer surplus — follow directly from the equilibrium prices, and are given in the Appendix.

#### 4.2.2 Stage II: Wholesale Price

In stage II, firm A picks the downstream duopoly wholesale price $\omega$ to solve

$$\max_{\omega} V_A^{dd2} = \frac{1}{r}\left[p_A(\omega)\, q_A^{dd2}(\omega) - k_A + \omega q_B^{dd2}(\omega)\right] \tag{12}$$

(see also (31)), subject to firm B's downstream duopoly participation constraint,

$$V_B^{dd2}(\omega) = \frac{1}{r}\left\{\frac{1-\sigma}{1+\sigma}\left[\frac{2+\sigma-2(1+\sigma)\omega}{4-\sigma^2}\right]^2 - k_B\right\} \geq 0. \tag{13}$$

The solution is one of two types, depending on whether the constraint is or is not binding. If firm B's participation constraint is not binding, the value-maximizing wholesale price is

$$\omega^{dd} = \frac{1}{2}\frac{8+\sigma^3}{8+\sigma^2}, \tag{14}$$

and firm B's equilibrium value satisfies

$$V_B^{dd} = \frac{1}{r}\left[\frac{1-\sigma}{1+\sigma}\left(\frac{2+\sigma^2}{8+\sigma^2}\right)^2 - k_B\right] \geq 0. \tag{15}$$

That is, for

$$k_B \leq \frac{1-\sigma}{1+\sigma}\left(\frac{2+\sigma^2}{8+\sigma^2}\right)^2 = k_B^* \tag{16}$$

— small $k_B$, given $\sigma$, or small $\sigma$, varieties are weak substitutes, given $k_B$ — firm B's participation constraint is not binding.

If (16) does not hold, $\omega^{dd}$ would make firm B's value negative. If firm B's participation constraint is binding, A must reduce $\omega$ below $\omega^{dd}$, allowing firm B to break even.[20] From (13), the participation-constrained wholesale price, the price that makes firm B's value 0, is

$$\omega^{cdd} = \frac{1}{2}\frac{2+\sigma}{1+\sigma}\left[1-(2-\sigma)\sqrt{\frac{1+\sigma}{1-\sigma}k_B}\right]. \tag{17}$$

For given $\sigma$, $\omega^{cdd}$ and firm A's constrained downstream duopoly value $V_A^{cdd}$ fall as $k_B$ rises. For given $k_B$, $\omega^{cdd}$ and $V_A^{cdd}$ fall as $\sigma$ rises (as varieties become closer substitutes).

One meets in the literature observations along the lines of that of Grout (2003, p. 78, footnote 10), "in many cases, the vertically integrated company will have no wish to exclude a more efficient downstream competitor providing it can extract more upstream profit by using the more efficient competitor rather than its own channels." For $k_B > k_B^*$, a dominant upstream firm would reduce the wholesale price to keep a downstream rival in the market precisely because by so doing it is able to sell the essential input to the downstream rival.

[20] We make a tie-breaking assumption that if firm A's dual distribution value is zero, it is willing to sell its variety of the product.

### 4.3 Equilibrium Choice of Downstream Market Structure: no TPR

In Stage I, firm A will maximize value with downstream duopoly if

$$V_A^{dd*} \geq \max\left(V_A^m, V_A^m\right), \tag{18}$$

where $V_A^{dd*}$ is either the unconstrained or the constrained Stage II value, depending on whether firm B's participation constraint is or is not binding.

From Table 1, on the right-hand side we have

$$r\max\left(V_A^{ex}, V_A^{ni}\right) = \max\left(\frac{1}{4} - k_A, \frac{1}{8}\right) = \begin{cases} \frac{1}{8} & \frac{1}{8} \leq k_A \leq \frac{1}{4} \\ \frac{1}{4} - k_A & 0 \leq k_A \leq \frac{1}{8} \end{cases} . \tag{19}$$

Firm A's choice is between downstream duopoly and own monopoly for $0 \leq k_A \leq \frac{1}{8}$, between downstream duopoly and firm B monopoly for $\frac{1}{8} \leq k_A \leq \frac{1}{4}$. We discuss the low-$k_A$ case here. Considering (9), this allows a maximum $k_A$ that is twice as great as the maximum $k_B$. We discuss the high-$k_A$ case, $\frac{1}{8} \leq k_A \leq \frac{1}{4}$, which is qualitatively similar, in an Appendix that is available on request from the authors.

If firm B's participation constraint is not binding, firm A's downstream duopoly value exceeds its exclusion value,

$$V_A^{dd} = \frac{1}{4} + \frac{1-\sigma}{(1+\sigma)(8+\sigma^2)} - k_A > \frac{1}{4} - k_A. \tag{20}$$

Thus if firm B's participation constraint is met ($k_B \leq k_B^*$), firm A supplies firm B with the essential input at wholesale price (14) and the downstream market is a duopoly in which firm B has positive value. For $k_B$ greater than but close to $k_B^*$, firm A maximizes value by setting the constrained downstream duopoly price (17). Firm B's value is zero, meaning it earns just a normal rate of return on investment. The larger is $k_B$, the lower is $\omega^{cdd}$ and the lower is firm A's constrained downstream duopoly payoff. For

$$k_B \leq \frac{1-\sigma}{1+\sigma}\left(\frac{2+\sigma^2+2\sqrt{1-\sigma^2}}{8+\sigma^2}\right)^2 \equiv k_B^{**}, \tag{21}$$

firm A's constrained downstream duopoly payoff is at least as great as its own-monopoly payoff. For $k_B > k_B^{**}$, firm A maximizes value by excluding firm B from the market.

If the transfer price rule is not a factor, firm A's choice of downstream market structure depends on product substitutability, $\sigma$, and on $k_B$. Summarizing the results, we have

**Theorem 1** *If* $0 \leq k_A \leq \frac{1}{8}$,

(a) for

$$0 \leq k_B \leq k_B^*,$$

firm B's participation constraint is met if firm A sets wholesale price $\omega^{dd}$ and firm A maximizes value if the downstream market is a duopoly;

(b) for

$$k_B^* < k_B \leq \min\left(\frac{1}{16}, k_B^{**}\right),$$

the firm B's participation constraint is met if firm A sets wholesale price $\omega^{cdd}$ and firm A maximizes value if the downstream market is a duopoly;

(c) for $\sigma$ such that there is a range of $k_B$ satisfying

$$k_B^{**} < k_B \leq \frac{1}{16},$$

firm A's value-maximizing choice is to exclude firm B and supply the downstream market as a monopolist.

Theorem 1 is illustrated in Figure 3. For a given value of $k_B$, if varieties are weak substitutes ($\sigma$ small), firm A can set the unconstrained downstream duopoly price and leave firm B positive value. Firm B's value is smaller for larger values of $\sigma$. For intermediate values of $\sigma$, firm A must set $\omega$ below $\omega^{dd}$ for firm B to just break even. For sufficiently large $\sigma$, the reduction in $\omega$ required to keep firm B in the market makes firm A's constrained downstream duopoly value less than its exclusion value.

Alternatively, for $0 \leq \sigma \leq 0.56871$, firm A's value-maximizing distribution choice passes from unconstrained to constrained downstream duopoly as $k_B$ rises. For $0.56871 < \sigma \leq 1$, there is an upper range of $k_B$ over which firm A opts to exclude firm B and supply the downstream market as a monopolist.

# 5 The Transfer Price Rule

## 5.1 When binding?

If the transfer price rule is in effect, a $(p_A, \omega)$-pair that would not allow firm A's downstream operation to realize a nonnegative pseudo-profit if it had to purchase the essential input on the same terms as firm B would be *defined* as a price squeeze monopolization violation of Section 2 of the Sherman Act or abuse of a dominant position in violation of Section 102 of the TFEU.[21] To avoid such findings, the pseudo-value of firm A's downstream unit,

$$\widehat{V}_{AD} = \frac{1}{r}\left[\left(p_A - \omega\right) q_A - k_A\right], \tag{22}$$

[21] This presupposes that firm A has a position of monopoly power for the purposes of U.S. antitrust law or a dominant position for the purposes of EU competition policy.

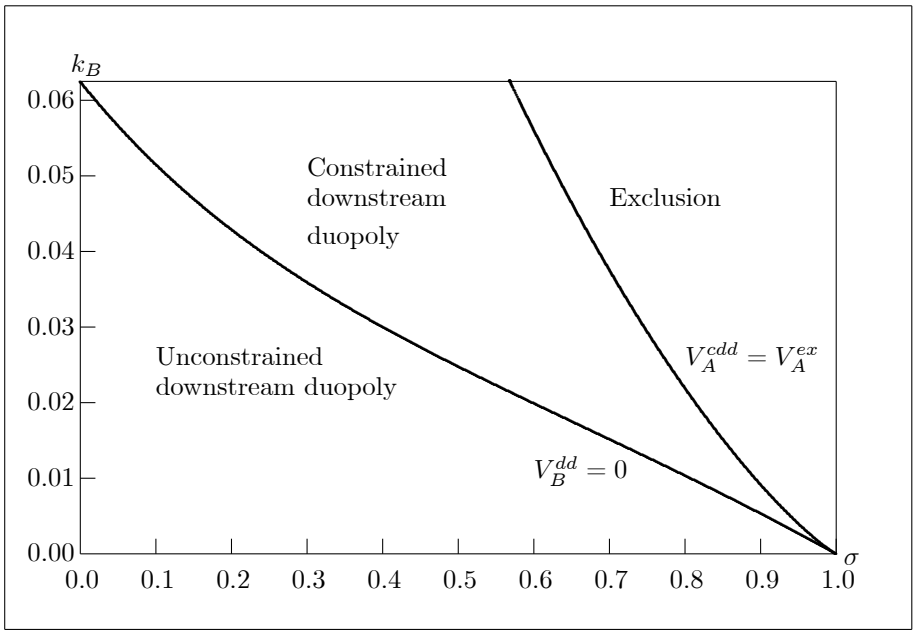


Figure 3: Firm A's choice of downstream market structure, low $k_A$.

must be nonnegative.

$\widehat{V}_{AD}$ satisfies

$$\widehat{V}_{AD} = \frac{1}{r}\left\{\frac{1-\sigma}{1+\sigma}\frac{[2+\sigma-(4+\sigma)\omega][2+\sigma-\sigma(1+\sigma)\omega]}{(4-\sigma^2)^2} - k_A\right\}. \tag{23}$$

When would the transfer price rule be a binding constraint on firm A's choice of $\omega$?

For $0 < k_B \leq k_B^*$ (that is, in the lower left region of Figure 3), the wholesale price $\omega^{dd}$ satisfies firm B's participation constraint. If we evaluate (23) for $\omega^{dd}$, the transfer price rule is satisfied for

$$k_A \leq \frac{1}{4}\frac{\sigma(1-\sigma)(2+\sigma)^2\left(4-\sigma+\sigma^2\right)}{(1+\sigma)\left(8+\sigma^2\right)^2} \equiv \widehat{k}_A. \tag{24}$$

For $k_B^* < k_B \leq k_B^{**}$ (in the central region of Figure 3), without the TPR firm A would set wholesale price $\omega^{cdd}$. If we evaluate (23) for $\omega^{cdd}$, the transfer price rule is satisfied for

$$k_A \leq \widetilde{k}_A \equiv \frac{1}{4}\frac{1-\sigma}{(1+\sigma)^2}\left[-1+(4+\sigma)\sqrt{\frac{1+\sigma}{1-\sigma}k_B}\right]\left(1+\sigma\sqrt{\frac{1+\sigma}{1-\sigma}k_B}\right). \tag{25}$$

If the wholesale price $\omega^{dd}$ satisfies firm B's participation constraint, the threshold value of $k_A$ at which the transfer price rule becomes a binding constraint, $\widehat{k}_A$, is independent of $k_B$. The threshold is drawn in Figure 4, and for the case that firm B's participation constraint is satisfied without the transfer price rule, the transfer price rule is a binding constraint above the $\widehat{V}_{AD} = 0$, $k_A = \widehat{k}_A$ line. If, without the TPR, firm B's participation constraint is binding and firm A sets wholesale price $\omega^{cdd}$, the threshold $\widetilde{k}_A$ at which the transfer price rule becomes a binding constraint depends on the value of $k_B$.[22]

## 5.2 If binding

If $\widehat{V}_{AD}^{cdd} < 0$ and firm A makes the downstream market a duopoly, the TPR is a binding constraint when firm A chooses $\omega$. In this case, firm A sets $\omega$ so $\widehat{V}_{AD} = 0$ (positive $\widehat{V}_{AD}$ would needlessly reduce firm A's value), anticipating the resulting prices that will be set in Stage III (Section 4.2.1). This wholesale price is

$$\omega^{tpr} = (2+\sigma)\frac{4+2\sigma+\sigma^2-(2-\sigma)\sqrt{(2+\sigma)^2+4\sigma(4+\sigma)\frac{(1+\sigma)^2}{1-\sigma}k_A}}{2\sigma(1+\sigma)(4+\sigma)}. \quad (26)$$

As one would expect, under the transfer price rule, firm A must set a lower $\omega$, the greater is $k_A$. Firm A's TPR-constrained value must be less than its value without the TPR. The lower wholesale price that comes with the TPR means that firm B's value must be greater if the TPR is in effect than if it is not. It follows that if firm B's participation constraint is satisfied without the TPR, it is satisfied with the TPR.

## 5.3 Equilibrium Choice of Downstream Market Structure: TPR

By the argument made in connection with (19), for $0 \leq k_A \leq \frac{1}{8}$ firm A will choose either downstream duopoly or exclusion. If the TPR is in effect, (26) gives the wholesale price if firm A chooses to make the downstream market a duopoly. Firm A prefers TPR-constrained downstream duopoly to exclusion for

$$V_A^{tpr} \geq V_A^{ex} = \frac{1}{r}\left(\frac{1}{4}-k_A\right), \quad (27)$$

and on some manipulation this condition becomes

$$k_A \leq \widehat{\widehat{k}}_A = \frac{1}{4\sigma}\frac{1-\sigma}{(1+\sigma)^2(4+\sigma)}\left\{\left[\frac{(2+\sigma)\left(8+2\sigma^2+\sigma^3\right)+2\sigma(4+\sigma)\sqrt{1-\sigma^2}}{8+\sigma^2}\right]^2-(2+\sigma)^2\right\}. \quad (28)$$

Since firm B's participation constraint is satisfied if firm A sets $\omega = \omega^{tpr}$, we have

[22] The threshold is drawn in three-dimensional diagrams in an Appendix that is available on request from the authors.

**Theorem 2** *If* $0 \leq k_A \leq \frac{1}{8}$,

(a) for $0 < k_B \leq k_B^*$ and $k_A \leq \widehat{k}_A$ or $k_B^* < k_B \leq k_B^{**}$ and $k_A \leq \widetilde{k}_A$, the TPR is not a binding constraint; firm A chooses downstream duopoly and sets wholesale price $\omega^{dd}$;

(b) for $0 < k_B \leq k_B^*$ and $\widehat{k}_A \leq k_A \leq \min\left(\frac{1}{8}, \widehat{\widehat{k}}_A\right)$ or $k_B^* < k_B \leq k_B^{**}$ and $\widetilde{k}_A \leq k_A \leq \min\left(\frac{1}{8}, \widehat{\widehat{k}}_A\right)$, the TPR is binding constraint; firm A chooses downstream duopoly and sets wholesale price $\omega^{tpr}$;

(c) for $\sigma$ such that there is a range of $k_A$ satisfying $\widehat{\widehat{k}}_A < k_A \leq \frac{1}{8}$, firm A's value-maximizing choice is to exclude firm B and supply the downstream market as a monopolist.

Theorem 2 is illustrated in Figure 4 for the $0 < k_B \leq k_B^*$ case (firm B's participation constraint satisfied without the TPR), which shows the $V_A^{tpr} = V_A^{ex}$ (or equivalently $k_A = \widehat{\widehat{k}}_A$) line.[23] For given $k_A$, there is a threshold value of the substitutability parameter $\sigma$ above which firm A maximizes value by excluding firm B from the downstream market. There is no analytic solution for the threshold value of $\sigma$. Alternatively, if varieties are weak substitutes, $0 \leq \sigma \leq 0.32956$, firm A will opt for TPR-constrained downstream duopoly for all $k_A$ in the $0 \leq k_A \leq \frac{1}{8}$. For $0.32956 < \sigma \leq 1$, there is a threshold value of $k_A$ above which the reduction in $\omega$ required to satisfy the TPR rule is so great that firm A maximizes value by excluding firm B from the downstream market.[24]

# 6 The TPR, firm A's choice of downstream market structure, and welfare consequences

If the TPR is not in effect, firm A's choice of downstream market structure depends on $k_B$ and $\sigma$ (Figure 3). If the TPR is in effect, firm A's choice of downstream market structure depends on $k_A$, $k_B$ and $\sigma$ (Theorem 2). The impact of the TPR on firm A's choice of downstream market structure partitions $(k_A, k_B, \sigma)$-space[25] into seven regions. In three of these regions, the TPR has no impact on firm A's choice of downstream market structure, either because the TPR is not a binding constraint or because firm A excludes firm B from the

[23] For $k_B^* < k_B \leq k_B^{**}$, $(\sigma, k_A)$-space is similarly partitioned into three regions. As noted above, for this case the threshold below which the TPR is not a binding constraint depends on $k_B$.

[24] The point that equilibrium market structure depends on the rules of the competitive game is not new to antitrust. In its 1967 *Schwinn* decision (U.S. *v.* Arnold, Schwinn & Co. *et al.* 388 U.S. 365 (1967)), the U.S. Supreme Court held that Schwinn could not impose nonprice restraints on independent distributors that had taken title to bicycles intended for resale. Following this decision, Schwinn internalized the distribution function, cutting off distributors with which it had had decades-long relationships.

[25] Where $0 \leq k_A \leq \frac{1}{8}$, $0 \leq k_B \leq \frac{1}{16}$, and $0 \leq \sigma \leq 1$.

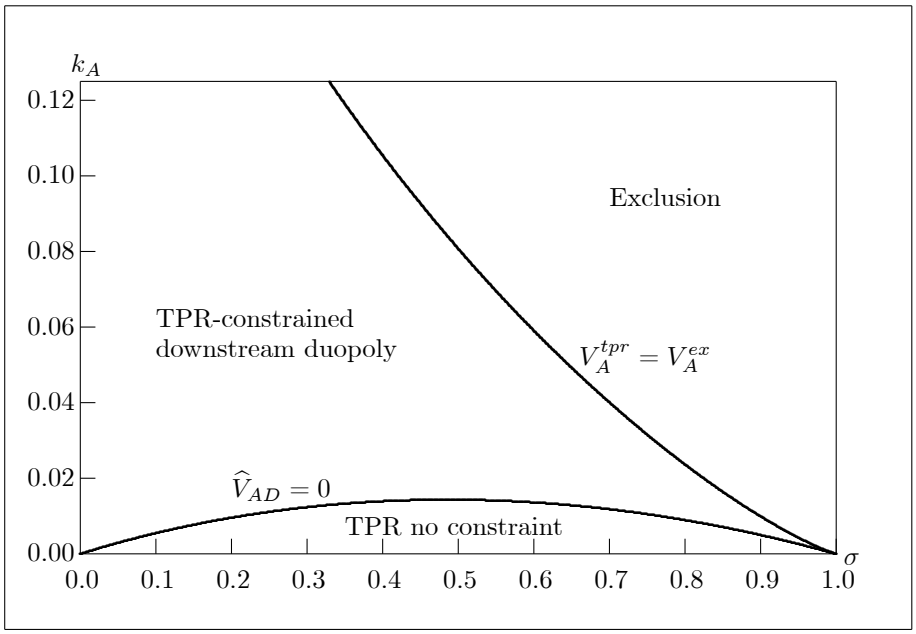


Figure 4: Firm A's choice of downstream market structure under the TPR, if the no-TPR choice is unconstrained downstream duopoly.

downstream market whether or not the TPR is in effect. In two of the regions, firm A chooses downstream duopoly with or without the TPR, setting the lower wholesale price $\omega^{cdd}$ if the TPR is in effect. In two of the regions, firm A opts for downstream duopoly without the TPR, exclusion with the TPR. The inequalities defining the various regions are summarized in

**Theorem 3** *(a) for* $0 < k_B \leq k_B^*$ *and*

- (Region 1) $k_A \leq \widehat{k}_A$, the TPR is not a binding constraint;
- (Region 2) $\widehat{k}_A \leq k_A \leq \min\left(\widehat{\widehat{k}}_A, \frac{1}{8}\right)$, firm A chooses unconstrained downstream duopoly without the TPR, TPR-constrained downstream duopoly with the TPR;
- (Region 3) $\widehat{\widehat{k}}_A \leq k_A \leq \frac{1}{8}$, for $\sigma$ where there is such a range, firm A chooses unconstrained downstream duopoly without the TPR, exclusion with the TPR;

(b) for $k_B^* < k_B \leq k_B^{**}$ and

- (Region 4) $k_A \leq \widetilde{k}_A$, the TPR is not a binding constraint;

- (Region 5) $\widetilde{k}_A < k_A \leq \min\left(\widehat{\widehat{k}}_A, \frac{1}{8}\right)$, firm A chooses constrained downstream duopoly without the TPR, TPR-constrained downstream duopoly with the TPR;

- (Region 6) $\widehat{\widehat{k}}_A \leq k_A \leq \frac{1}{8}$, for $\sigma$ where there is such a range, firm A chooses constrained downstream duopoly without the TPR, exclusion with the TPR;

  (c) (Region 7) for $k_B^{**} < k_B \leq \frac{1}{16}$, if such a range exists, firm A will choose to supply the downstream market as a monopolist whether or not the TPR is in effect.

The regions are irregularly shaped, but the regions where the TPR makes a difference for firm A's choices may be approximately described as follows.[26] Region 2 is roughly all $k_A$, low to intermediate $\sigma$, and low to intermediate $k_B$. Region 3 is roughly all $k_A$, intermediate to high $\sigma$, and low to intermediate $k_B$. Thus for low $k_B$ ($k_B \leq k_B^*$), it is high product substitutability that is conducive to exclusion under the TPR. Region 5 is roughly low to intermediate $k_A$, low to intermediate $\sigma$, and intermediate to high $k_B$. Region 6 is roughly intermediate to high $k_A$, intermediate $\sigma$, and intermediate to high $k_B$. Thus for intermediate values of $k_B$ ($k_B^* < k_B \leq k_B^{**}$), it is high $k_A$ that is conducive to exclusion under the TPR.

Table 2 reports the impact of the TPR on the elements of market performance in the four regions where the TPR alters firm A's choices. Where the TPR is a binding constraint on firm A's choices, it must reduce firm A's value, compared with the no-TPR equilibrium. Imposition of the TPR increases firm B's value in regions 2 and 5, where firm A supplies firm B the essential input at a lower price than it would without the TPR. In regions 3 and 6, the TPR means firm B is excluded from the downstream market. Its exclusion value, 0, is less than its unconstrained downstream duopoly value (region 3), and the same as its constrained downstream duopoly value (region 6). The TPR increases the combined value of both firms in almost all of region 2 and in region 5; it reduces combined firm value in regions 3 and 6. The TPR increases the present-discounted value of consumer surplus, and net social welfare, in regions 3 and 5. It reduces consumer surplus in most of regions 3 and 6, and reduces net social welfare in all of regions 3 and 6.

The common element of these results is that the TPR increases consumer surplus and net social welfare if firm B remains active under the TPR. If imposition of the TPR leads firm A to exclude firm B, consumer surplus is almost always reduced, and net social welfare is always reduced. These results are consistent with the expectation that actual competition improves market performance.

[26] The regions are illustrated in a series of figures in an appendix that is available on request from the authors.

| Region | 2 | 3 | 5 | 6 |
|---|---|---|---|---|
| No TPR | Udd | Udd | Cdd | Cdd |
| TPR | TPRdd | Ex | TPRdd | Ex |
| $V_A$ | $-$ | $-$ | $-$ | $-$ |
| $V_B$ | $+$ | $-$ | $+$ | 0 |
| $V_A + V_B$ | $+^*$ | $-$ | $+$ | $-$ |
| $CS$ | $+$ | $-^{**}$ | $+$ | $-^{***}$ |
| $NSW$ | $+$ | $-$ | $+$ | $-$ |

Table 2: Welfare impact of the transfer price rule, by region. Udd indicates unconstrained downstream duopoly, Cdd indicates constrained downstream duopoly; + indicates increase, − indicates decrease. *Except for a small high-$\sigma$, low-$k_A$ region; **Except for a small high-$\sigma$ region; ***Except for a small high-$\sigma$, low- to intermediate-$k_B$ region.

# 7 Robustness

In Martin and Vandekerckhove (2010), we explore a generalization of the model that allows for vertical as well as horizontal product differentiation. Qualitative results are similar to those presented here. In contrast to the equal-quality case, however, if firm B's variety is of much higher quality than firm A's variety, imposition of the TPR may lead firm A not to enter the downstream market. In such cases, the TPR reduces firm A's value and may slightly increase or decrease firm B's value. Double marginalization means that consumer surplus and net social welfare decline if the downstream market is supplied only by firm B under the TPR, compared to duopoly supply without the TPR. Once again, the results are consistent with the expectation that actual competition improves market performance.

# 8 Conclusion

The words of Section 2 of the Sherman Act refer to monopolization. The life that judicial interpretation has breathed into this clay deals with conduct that is exclusionary. The prohibition of abuse of a dominant position contained in Article 102 of the Treaty on the Functioning of the European Union is more complex, touching on exclusionary conduct but also on the exercise of market power and evincing a special responsibility of dominant firms to conduct themselves in such a way that competition in the single market is not distorted.

What is perhaps the classic rationale for an antimonopolization policy appears in the first U.S. antitrust decision of which we are aware to involve a claim of vertical price squeezing:[27]

> The national will has not declared against elimination of competitors when they fail from their inherent industrial weakness. On the

[27] U.S. *v.* Corn Products Refining Co. *et al.* 234 F. 964 (1916), at 1015.

> contrary, it has declared with great emphasis against any methods by which such weaknesses might be concealed; in so doing it has assumed a positive purpose toward industry, has established a norm to which competition must conform. This purpose the Corn Products Refining Company has persistently and ingeniously endeavored to thwart from the outset. Its constant effort has been to prevent competitors from that test which would in the long run discover whether they could manufacture as well and as cheaply as itself.

The transfer price rule, if it were in effect, would protect for nonintegrated firms the right to fail if they are not as efficient as the downstream unit of the integrated firm. In so doing, the TPR generally increases consumer surplus and net social welfare, provided it does not induce the upstream firm to exclude the downstream firm from the market, something that happens, roughly, if varieties are good substitutes and the upstream firm has high fixed cost.[28]

If, as is permissible under U.S. antitrust law, a vertically-integrated firm may simply refuse to deal with downstream competitors, the TPR can induce exclusion that would not otherwise take place. In such cases, the TPR generally reduces consumer surplus and net social welfare. In such cases, it is exclusion that worsens market performance, and competition that improves it. But the right of an antitrust monopolist to refuse to deal with customer/competitors is not unlimited. The *Colgate*[29] doctrine is that (emphasis added) "*In the absence of any purpose to create or maintain a monopoly*, the [Sherman] act does not restrict the long recognized right of trader or manufacturer engaged in an entirely private business, freely to exercise his own independent discretion as to parties with whom he will deal." *linkLine* permits exclusionary intermediate good prices if the upstream firm has no "antitrust duty to deal" with its downstream competitor/customers. Just when an upstream firm has, or should have, a duty to deal with downstream firms, is itself a policy question. The impact of alternative policies toward refusal to deal on static and dynamic market performance could also be the subject of the kind of explicit welfare analysis we have presented for the transfer price rule.[30]

# 9 Appendix

Complete details of derivations are given in a separate appendix that is available on request from the authors.

[28] Practical issues would need to be faced to implement the transfer price rule, as for example practical issues arise in application of the Areeda-Turner rule. Motta and de Streel (2006) have a careful discussion of issues in measuring costs for the purpose of price squeeze analysis.

[29] U.S. v. Colgate & Co. 250 U.S. 300 (1919) at 307.

[30] The *Colgate* doctrine originally meant that the manufacturer of a branded consumer good could select its distributors. Context matters, and the welfare impact of an upstream firm's refusal to deal in such a circumstance may be quite different from the welfare impact of a vertically-integrated firm's refusal to supply an essential input to downstream competitors that market their own branded consumer goods.

## 9.1 Table 1

Column 1 of Table 1 is the monopoly outcome if firm A is the unique supplier of the downstream market. Column 2 is the double marginalization outcome.

## 9.2 Downstream duopoly: firm B's participation constraint met

### 9.2.1 Stage III

Substituting the demand equations (3) and (4) into the payoff functions (10) and (11) gives the firms stage III objective functions. Solving the first-order conditions to maximize these objective functions gives stage III equilibrium prices as functions of the wholesale price,

$$p_A = \frac{(1-\sigma)(2+\sigma)+3\sigma\omega}{4-\sigma^2} \tag{29}$$

and

$$p_B = \omega + (1-\sigma)\frac{2+\sigma-2(1+\sigma)\omega}{4-\sigma^2}. \tag{30}$$

All stage III equilibrium characteristics of interest — quantities demanded, payoffs, consumer surplus, and net social welfare — can be obtained from the equilibrium prices. Values as functions of $\omega$ are

$$V_A^{dd2} = \frac{1}{r}\times$$

$$\left[\frac{(1-\sigma)(2+\sigma)^2+(1+\sigma)(2+\sigma)\left(4-2\sigma+\sigma^2\right)\omega-(1+\sigma)\left(8+\sigma^2\right)\omega^2}{(1+\sigma)\left(4-\sigma^2\right)^2}-k_A\right] \tag{31}$$

and

$$V_B^{dd2} = \frac{1}{r}\left\{\frac{1-\sigma}{1+\sigma}\left[\frac{2+\sigma-2(1+\sigma)\omega}{4-\sigma^2}\right]^2-k_B\right\}. \tag{32}$$

(31) and (32) correspond to (12) and (13), respectively.

$V_A^{dd2}$ is firm A's stage II objective function. $V_B^{dd2}$ must be nonnegative for firm B's participation constraint to be met.

### 9.2.2 $\omega$

The first-order condition to maximize $V^{dd2}$ gives firm A's optimal wholesale price, (14), if this wholesale price satisfies firm B's participation constraint. Substituting (14) in (31) and (32) gives stage III equilibrium values.

Price-cost margins are

$$p_A^{dd} = \frac{1}{2}\frac{(4-\sigma)(2+\sigma)}{8+\sigma^2} \tag{33}$$

and

$$p_B^{III} - \omega = \frac{(1-\sigma)\left(2+\sigma^2\right)}{8+\sigma^2}. \tag{34}$$

Expressions for quantities demanded are obtained from the first-order conditions. Equilibrium values are

$$V_A^{dd} = \frac{1}{r}\left[\frac{1}{4} + \frac{1-\sigma}{(1+\sigma)(8+\sigma^2)} - k_A\right]. \tag{35}$$

and (15).

Firm B's participation constraint is satisfied for $k_B \leq k_B^*$ (see (16). If (14) does not satisfy firm B's participation constraint, firm A can set a lower wholesale price, (17), that makes $V_B^{dd2} = 0$. Firm A's constrained downstream duopoly value satisfies

$$V_A^{cdd} = V_A^{ex} + \frac{1}{r}\left[\frac{1-\sigma}{(1+\sigma)(8+\sigma^2)} - \frac{8+\sigma^2}{(4-\sigma^2)^2}\left(\omega^{dd} - \omega^{cdd}\right)^2\right]. \tag{36}$$

$V_A^{cdd} > V_A^{ex}$ for $\omega^{cdd}$ near $\omega^{dd}$. As $k_B$ rises and $\omega^{cdd}$ falls, a threshold value (21) is reached at which $V_A^{cdd} = V_A^{ex}$, and for larger $k_B$, firm A prefers exclusion to constrained downstream duopoly.

## 9.3 Transfer Price Rule

The transfer price rule requires that the pseudo-profit $\widehat{V}_{AD}$ of firm A's downstream unit, (22) or (23), be nonnegative. Setting $\widehat{V}_{AD} = 0$ for $\omega = \omega^{dd}$ gives the threshold value $\widehat{k}_A$,(24). For $k_A > \widehat{k}_A$ the TPR is a binding constraint if firm B's participation constraint would be met without the TPR. Setting $\widehat{V}_{AD} = 0$ for $\omega = \omega^{cdd}$ gives the threshold value $\widetilde{k}_A$, (25). For $k_A > \widetilde{k}_A$ the TPR is a binding constraint if firm B's participation constraint would not be met without the TPR. If the TPR is a binding constraint and firm A opts for downstream duopoly, it sets $\omega$ so $\widehat{V}_{AD} = 0$. If set equal to 0, (23) is a quadratic equation in $\omega$ and can be solved for $\omega^{tpr}$, (26).

All equilibrium characteristics of interest can be found from $\omega^{tpr}$. In particular, firm A's downstream duopoly value under the TPR is

$$V_A^{tpr} = \frac{1}{r}\frac{2+\sigma}{4\sigma^2(1+\sigma)^2(4+\sigma)}\left[4+2\sigma+\sigma^2-(2-\sigma)\sqrt{(2+\sigma)^2+4\sigma(4+\sigma)\frac{(1+\sigma)^2}{1-\sigma}k_A}\right]$$

$$\times\left[-\left(4-2\sigma-\sigma^2\right)+(2+\sigma)\sqrt{(2+\sigma)^2+4\sigma(4+\sigma)\frac{(1+\sigma)^2}{1-\sigma}k_A}\right]. \tag{37}$$

Comparing $V_A^{tpr}$ and $V_A^{ex}$ gives $\widehat{\widehat{k}}_A$, (28), the threshold value above which firm A will opt for exclusion under the TPR.

Comparing equilibrium values if the TPR is and is not in effect gives the comparative static changes the signs of which are indicated in Table 2.

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